

# **Proposed Indicators for Interim Goals and Benchmarks for the Comprehensive Everglades Restoration Plan**

**Prepared by a RECOVER sub-team**

## **Introduction**

### **Purpose of Document**

This document presents the lists of proposed indicators that will be used for 1) establishing interim goals for restoration of the natural system and 2) creating benchmarks<sup>1</sup> for other water-related needs in support of the Comprehensive Everglades Restoration Plan (CERP or the Plan). These interim goals and benchmarks, once determined, will be used for tracking the progress of CERP throughout the implementation of the Plan towards meeting its goals and purposes. Each of the proposed indicators is described in this document by a goal statement that is accompanied by a brief explanation of the significance of the indicator as an interim goal or benchmark. The purpose of this document is to provide the list of proposed indicators for public and agency review and comment during a 30-day review period (10 December 2002 through 09 January 2003). Written comments on this document should be submitted to Betty Grizzle ([betty\\_grizzle@fws.gov](mailto:betty_grizzle@fws.gov)) and Elizabeth Crisfield ([elizabeth\\_crisfield@nps.gov](mailto:elizabeth_crisfield@nps.gov)) no later than January 9, 2003.

### **Background and Authority**

Development of a process to establish interim goals to "ensure the protection of the natural system consistent with the goals and purposes of the Plan" is a requirement of the Water Resources Development Act (WRDA) of 2000 (Public Law 106-541), the authorizing legislation for CERP. The draft Programmatic Regulations for the Comprehensive Everglades Restoration Plan (DOD, 2002) provide that the Restoration Coordination and Verification (RECOVER) program recommend a set of interim goals and evaluate progress on achieving other water-related needs of the region provided for in the Plan. The proposed programmatic regulations also establish guidance and policy for the development of interim goals and benchmarks and require an Interim Goals Agreement that will memorialize the interim goals and facilitate inter-agency planning, monitoring, and assessment to evaluate the progress toward the achievement of the established interim goals. RECOVER, as the science and technical program in support of CERP implementation, has been charged with the development of the process to establish

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<sup>1</sup> Note: the term "benchmarks" is used in this document in place of the term "targets" for other water-related needs used in the proposed programmatic regulations. The RECOVER team determined that the term "target" was unclear and confusing. Other uses of the word 'target' in other documents made it difficult to apply to the "other water-related" objectives of CERP.

interim goals and a RECOVER subteam has developed an initial set of proposed indicators for the interim goals and benchmarks. Additional details of this process are presented in Appendix A.

The establishment of both interim goals and benchmarks will guide the implementation of CERP by providing assurance during the critical first phases of implementation that cooperative efforts have resulted in tangible and measurable improvements.

### **Definitions and Descriptions of Interim Goals and Benchmarks**

Interim goals are designed to establish incremental targets to evaluate progress toward the expected level of performance of the Plan. Interim goals represent predictions of achievements in the natural system during the implementation of CERP and can be “milestones,” i.e., quantitative targets, or they may represent “trends,” i.e., directions of change. The list of indicators for interim goals has been grouped by three general categories – hydrologic, water quality, and ecological indicators. This grouping represents the team’s interest in ensuring that the goals adequately represent the full range of expected benefits to the Plan. For this reason, the team selected indicators from representative physical and water quality stressors and ecological attributes identified by the conceptual ecological models used in the development of the RECOVER Monitoring and Assessment Plan (RECOVER, 2002). When selecting indicators, the team also considered the following criteria for developing interim goals, which were developed during a team workshop in April 2002 (see Appendix B). Goals should: 1) be consistent with the goals and purposes of CERP, 2) address the physical and biological aspects of the Plan, 3) be consistent with the RECOVER Monitoring and Assessment Plan or through hydrologic simulations, and 4) be predictable and easily interpreted. Appendix B provides additional information on these criteria and guidelines for the selection of interim goals. The list of proposed interim goal indicators is shown in Table 1.

Benchmarks for other water-related needs represent predictions of progress towards providing for other water-related needs of the region, such as water supply and flood protection. Other socio-economic goals for CERP (i.e., recreation and navigation) are also not included in this initial benchmark list of other water-related needs indicators, but may be considered in future lists. The list of proposed benchmarks is shown in Table 2.

### **Process for Developing Indicators for Interim Goals and Benchmarks**

Consistent with the RECOVER interim goal process document (Appendix A), this document has been prepared as a means of providing for agency and public review of an initial list of proposed indicators. This document meets the requirements of step number three in the RECOVER “Process to establish and refine interim goals for the Comprehensive Everglades Restoration Plan” (see Appendix A). Following public review of this list of proposed indicators, the RECOVER team will prepare a revised list of indicators (step four in the process). The team recognizes a level of uncertainty in the quantification of these proposed indicators and their targets. Revision, addition, or deletions to the final, accepted indicators is expected periodically throughout project

implementation as new data become available as part of the monitoring and assessment program. This adaptive process will ensure that the interim goals for restoration and benchmarks for other water-related needs are revised as appropriate.

Once the initial list of indicators is determined through the public review process, the RECOVER subteam will prepare a second report that will provide the actual goals and benchmarks for each of the approved indicators (step seven of the process). As shown in Figure 1 of Appendix A, the team will be scheduling technical discussions with appropriate experts to define the incremental targets for each indicator. It is anticipated that actual goals and benchmarks for the approved lists of indicators will be established and reported at five-year intervals during the implementation of the Plan.

**Table 1. Proposed Indicators for Interim Goals**

ID	Title	Type	Applicable Region
1.1	System-wide Distribution of New Available Water	Hydrology (Quantity)	System-wide
1.2	Volume	Hydrology (Distribution)	Greater Everglades
1.3	Sheetflow	Hydrology (Distribution)	Greater Everglades
1.4	Hydroperiod	Hydrology (Timing and Distribution)	Greater Everglades
1.5	Hydropattern	Hydrology (Distribution)	Greater Everglades
1.6	Volume of Freshwater Inflows to Estuaries	Hydrology (Quantity and Timing)	Estuaries
1.7	Distribution of Freshwater Inflows to Estuaries	Hydrology (Distribution)	Estuaries
1.8	Water Stages in Lake Okeechobee	Hydrology (Quantity)	Lake Okeechobee
2.1	Total Phosphorus	Water Quality	System-wide
2.2	Salinity Regimes	Water Quality	Estuaries
2.3	Lake Okeechobee Water Quality	Water Quality	Lake Okeechobee
3.1	Recovery of Threatened and Endangered Species and supporting habitats	Ecology (wildlife)	System-wide
3.2	Wading Bird Nesting Patterns	Ecology (wildlife)	System-wide
3.3	American Alligator Distribution and Abundance	Ecology (wildlife)	System-wide
3.4	Periphyton Mat Cover, Structure and Composition	Ecology	Greater Everglades
3.5	Aquatic Fauna Regional Populations	Ecology (wildlife)	Greater Everglades
3.6	Ridge and Slough	Ecology (landscape)	Greater Everglades
3.7	Everglades Tree Islands	Ecology (vegetation)	Greater Everglades

3.8	Spatial Extent of Habitat Type	Ecology (landscape)	Greater Everglades
3.9	Mercury Bioaccumulation	Ecology (wildlife)	Greater Everglades
3.10	Submerged Aquatic Vegetation in Estuaries	Ecology (vegetation)	Estuaries
3.11	American Oysters in Estuaries	Ecology (wildlife)	Estuaries
3.12	Lake Okeechobee Ecological Communities	Ecology	Lake Okeechobee

**Table2. Proposed Benchmarks for Other Water-Related Needs**

ID	Title
1.1	Ability to Meet Water Supply Needs in the Lower East Coast Service Area
1.2	Ability to Meet Water Supply Needs in the Lake Okeechobee Service Area
1.3	Ability to Prevent Saltwater Intrusion of the Biscayne Aquifer
1.4	Maintenance of Current Level of Flood Protection

## Proposed List of Indicators for Interim Goals

### 1. Hydrology

#### 1.1 System-wide Distribution of New Available Water

**Goal Statement:** Shift the quantities of water available to the natural system and to urban and agricultural users. This interim goal would be used to measure the storage and distribution of ‘new available water’ by calculating changes in the water volume entering and exiting basins in a water budget map. The goal is to provide the volume of water to the natural system that is needed to meet the hydrological restoration goals in each region.

**Significance:** Ecosystem benefits depend upon the improvement of water quantity, quality, timing, and distribution. The increase in regional storage capacity provided by CERP will make these hydrologic improvements possible by increasing the available source water. Approximately 80 percent of the ‘new available water’ provided by this increase in regional storage capacity is expected to be available to the natural system as projected by calculations provided in the Restudy. Legislators and the public recognize this aspect of CERP as being very important to the successful restoration of the Everglades.

#### 1.2 Volume

**Goal Statement:** Restore more natural volumes of water throughout the Everglades Protection Area. The measure for this interim goal is the volume of average annual wet season and dry season deliveries and retention in the Everglades Protection Area.

**Significance:** Substantial reductions in the total volume of water delivered to or retained in the remaining greater Everglades and Big Cypress basins caused by water management practices has adversely altered historical patterns of fire and soil accretion, the production and survival of aquatic animals, and plant community patterns. The volumes necessary to sustain extensive patterns of sheet flow in wet seasons, and to keep the deeper sloughs from drying during the dry season, has not been available in most years in the managed system. The implementation of CERP is expected to provide enough water to the natural system to recover some of the ecological features that characterized a healthy Everglades system.

#### 1.3 Sheetflow

**Goal Statement:** Improve sheetflow in the natural areas. This interim goal would be used to measure incremental improvements in the spatial extent and quality of sheetflow in the Greater Everglades.

**Significance:** Broad, uninterrupted overland flow (sheetflow) was a characteristic of the Everglades. The restoration goals of CERP include sheetflow, which is associated with more natural hydropatterns. The implementation of CERP is expected to improve the spatial extent of this characteristic flow regime by modifying and eliminating barriers to overland flow.

#### 1.4 Hydroperiod

**Goal Statement:** Improve hydroperiods throughout the system. This interim goal will be used to measure the incremental improvements in dry, average, and wet year hydroperiods in each model cell within the Greater Everglades.

**Significance:** The annual duration of land surface inundation (hydroperiod) determines in large part the flora and fauna associated with a specific location. Because of this strong linkage, hydroperiod has long been considered an important indicator of a functioning ecosystem. Implementation of CERP components is expected to improve the spatial distribution of hydroperiods by modifying the water management system.

#### 1.5 Hydropattern

**Goal Statement:** Improve the spatial distribution of water depth. This interim goal will be used to measure incremental improvements in spatial distribution of wet and dry season depth within the greater Everglades.

**Significance:** The spatial distribution of water depth has important implications for the interconnectedness of habitat types. The wetting and drying fringes can be assessed through examination of water depth maps. The implementation of CERP is expected to produce a spatial distribution of water depths that more closely matches the target hydropattern by modifying the water management system.

#### 1.6 Volume of Freshwater Inflows to Estuaries

**Goal Statement:** Improve quantity and timing of freshwater releases to the estuaries. This interim goal will be used to measure the seasonal timing and interannual variability of freshwater entering the estuaries.

**Significance:** Restoration of the salinity regimes (and dependent vegetation and aquatic organisms) will result from more natural freshwater releases to the estuaries. Implementation of CERP components will improve the timing of freshwater releases to the estuaries.

## 1.7 Distribution of Freshwater Inflows to Estuaries

**Goal Statement:** Reduce the negative effects on the estuaries associated with point source freshwater discharges. This interim goal will be used to measure the improvement in the broad distribution of freshwater flows along the coasts.

**Significance:** It is well recognized that the most effective way to produce beneficial salinity patterns is to provide freshwater releases to estuaries with a flow regime that is more evenly distributed in time and space. Several CERP projects have this redistribution as a goal, with the expectation that it will also serve to reconnect the freshwater marshes and the coastal fringe.

## 1.8 Water Stages in Lake Okeechobee

**Goal Statement:** Provide a reduced frequency and duration of adverse high and low water stages, in conjunction with an increased frequency of predictable spring recession events. The interim goal for this indicator will measure the frequency of extreme low and high lake stage events and spring recession events (with no reversals) from January to June.

**Significance:** Water levels (stage patterns) in Lake Okeechobee represent a significant hydrological and ecological stressor that affects rate of lake eutrophication, spatial extent and overall health of submerged and emergent plant communities, fish and wildlife resources, and water quality. Restoration of a more beneficial water regulation schedule should produce a more natural pattern of lake stage variability. Providing a beneficial hydrologic pattern is expected to increase the spatial extent and diversity of native submerged and emergent plant communities and improve important foraging and sheltering habitat for wading birds, native fish, and other wildlife.

# 2. Water Quality

## 2.1 Reduction in Total Phosphorus

**Goal statement:** Reduce unnaturally high levels of total phosphorus in the Everglades marshes. A total phosphorous index will be developed to measure the recovery or further degradation of the Everglades. The total phosphorus interim goal will be used to measure concentrations and amounts of total phosphorus in surface water and soils, in algae (periphyton) and aquatic plants, and in biological measures, such as the species composition of periphyton mats and the expanse of cattails.

**Significance:** Historically, the Everglades was a low total phosphorous system, with total nitrogen as the primary nutrient provided via rainfall. Most natural populations of Everglades flora and fauna are adapted to low phosphorus levels. Sawgrass communities account for approximately 65 to 70 percent of the total

vegetation cover in the Everglades. In many areas, the sawgrass is interspersed with more open ecosystem communities, such as wet prairies, containing sedges and grasses, and deeper-water sloughs, containing water lilies, bladderwort, and other aquatic species. These open-water habitats can be characterized by an abundant native periphyton community (floating and attached algal mats) that provides both habitat and a food source for invertebrates and fish. Anthropogenic total phosphorus enrichment has resulted in the conversion of open-water habitat and sawgrass areas into dense cattail stands. Historically, cattail was a minor component of the Everglades flora and is believed to have occurred primarily in naturally enriched or disturbed locations. No evidence has been found from the pre-drainage system for the existence of dense cattail stands such as those that now occur over extensive parts of the northern Everglades.

## 2.2 Salinity Regimes

**Goal Statement:** Improve salinity regimes in estuaries. This interim goal will be used to evaluate seasonal salinity fluctuations and inter-annual variability in salinity envelopes.

**Significance:** Restoration of the salinity regimes (and dependent vegetation and aquatic organisms) will result from more natural freshwater releases to the estuaries. The immediate improvements in the salinity regime associated with these improvements in water management will, over time, result in observable improvements in aquatic organisms.

## 2.3 Lake Okeechobee Water Quality

**Goal Statement:** Provide an improvement in water quality for Lake Okeechobee, with particular focus on average total phosphorus concentrations in open water. The interim goal for this indicator will measure the lake's pelagic total phosphorus concentrations and monthly total phosphorus loads into the lake.

**Significance:** Elevated levels of total phosphorus are largely responsible for the rapid eutrophication of Lake Okeechobee in the last two decades. This has been caused by excessive total phosphorus inputs from the surrounding watershed. A reduction in lake water total phosphorus as a result of implementation of CERP projects (in conjunction with the Lake Okeechobee Protection Program) is expected to result in: 1) reduced frequency and intensity of nuisance/toxic algal blooms, 2) increased diversity of benthic macro-invertebrates, 3) decreased rate of cattail expansion, and 4) increased spatial extent of submerged plant communities.

# 3. Ecology

## 3.1 Recovery of Threatened and Endangered Species and Supporting Habitats



**Goal Statement:** Promote the recovery of species of concern (federal and state listed species) by restoring pre-drainage hydrological patterns that result in restoration of native habitat. Other restoration elements essential for recovery include establishment of habitat linkages and connectivity, maintaining spatial extent of ecological communities as native habitat, and maintaining natural fire regimes. In addition to habitat condition attributes (i.e., hydropatterns, spatial extent, habitat connectivity), measurement of abundance and distribution of special interest species such as the wood stork, Florida panther, Everglade snail kite, West Indian manatee, eastern indigo snake, and federal and state-listed plant species at a system-wide level can provide an indicator of recovery for this system-wide goal.

**Significance:** Recovery of listed species is a critical element of the South Florida Ecosystem Restoration Initiative as established by South Florida Ecosystem Restoration Task Force. Restoration objectives at the community level focus on maintaining and enhancing the structure, function, and ecological processes of the community type and, to some extent, increasing the spatial extent of these communities.

### 3.2 System-wide Wading Bird Nesting Patterns

**Goal Statement:** Recover healthy populations of wading birds throughout the greater Everglades basin. Wading bird population health is determined by system-wide patterns of nesting, and includes measurements of three variables: numbers of nesting birds, locations of nesting colonies, and timing of nesting.

**Significance:** The number of wading birds nesting in the freshwater and estuarine Everglades basin declined by 90 to 95 percent between the early 1930s and the 1980s. Primarily since the 1960s, most wading birds abandoned the traditional colony sites in the southern Everglades, and several species changed the timing of nesting by 1 to 3 months. These changes in nesting numbers and patterns have been largely caused by adverse water management practices. Because wading birds are highly mobile and opportunistic, and because much is known of their habitat requirements, they are excellent indicators of the system-wide health of the Everglades ecosystem. It is expected that the implementation of CERP will recover more natural system-wide hydropatterns, which will promote the recovery of more natural wading birds nesting patterns in South Florida.

### 3.3 System-Wide American Alligator Distribution and Abundance

**Goal Statement:** Restore more natural numbers and distribution patterns for alligators across South Florida's major freshwater and estuarine wetland landscapes. Parameters to be measured for this interim goal include abundance and density throughout the ridge and slough Everglades, more natural patterns of

sizes of animals, habitat restoration, and the recovery of healthy “populations” in the southern marl prairies and estuarine rivers and creeks.

**Significance:** Alligators are a keystone species in the South Florida wetlands, in that they play a major role in influencing the overall health and ecological patterns of the region. Regionally, overall numbers of alligators have substantially declined, and distribution patterns greatly altered, as a result of water and land management practices. Overdrained wetlands and reductions in numbers of alligators have caused the loss of many small ponds (“holes”) that were essential for the survival of small aquatic animals during dry seasons. It is expected that CERP will result in the recovery of more natural hydropatterns regionally, which in turn will promote the recovery of healthy alligator patterns.

### 3.4 Periphyton Mat Cover, Structure, and Composition

**Goal Statement:** Restore the periphyton communities as functional bases of aquatic food webs in the greater Everglades wetlands. The interim goal for this ecological indicator will measure periphyton parameters such as biomass, tissue phosphorus, species composition in Greater Everglades wetland communities.

**Significance:** Periphyton mats represent an important food base that supports the intermediate trophic level marsh fishes and macro-invertebrates upon which wading birds and other higher vertebrates feed. The restoration of hydrology is expected to enhance the cover, structure, and composition of periphyton mats, which are considered to be regional indicators of functional bases of Everglades food webs.

### 3.5 Regional Populations of Aquatic Fauna

**Goal Statement:** Restore the density and size structure of marsh fishes and other aquatic fauna to levels that support sustainable breeding populations of higher vertebrates in the greater Everglades wetlands. The interim goal for this ecological indicator will measure the regional population densities and distribution of marsh fishes and associated aquatic fauna.

**Significance:** Marsh aquatic fauna represent an important intermediate trophic level upon which wading birds and other higher vertebrates feed. The restoration of hydrologic conditions should result in enhanced primary production of aquatic fauna such as marsh fishes, crayfish, grass shrimp, and aquatic amphibians.

### 3.6 Ridge and Slough

**Goal Statement:** Improve conditions that support natural soil forming processes and protect microtopography. This interim goal will be used to measure incremental improvements in vegetative patterns of the ridge and slough landscape in the Greater Everglades.

**Significance:** CERP goals include improvements in soil forming processes, habitat, and plant and animal abundance and diversity. The heterogeneity of the ridge and slough landscape supports this diversity. The changes in the flow regime and water depths, caused by CERP, will improve the soil-forming processes and consequently the microtopography characteristic of the ridge and slough landscape.

### 3.7 Everglades Tree Islands

**Goal Statement:** Improve the health of tree islands in all Water Conservation Areas and within Everglades National Park that are considered to be stressed or degraded; maintain the status of healthy islands and, where hydrologic conditions have reduced tree island area, prevent any further reduction. The tree island interim goal will be used to measure tree island native canopy density and diversity, understory composition and structure, exotic plant density, and tree growth.

**Significance:** Tree islands occur throughout the Everglades marshes. Tree islands are small, isolated forest patches that historically have provided essential habitat for a variety of plants and animals. Tree islands provide foraging and sheltering habitat for wildlife, especially during periods of high water, and provide nesting sites for wading birds and herptofauna (e.g., freshwater turtles). Tree islands are archaeologically important and have significant cultural importance to both the Miccosukee Tribe of Indians and the Seminole Tribe of Florida.

### 3.8 Spatial Extent of Habitat (or Landscape) Type

**Goal Statement:** Restore the spatial extent of slough and short-hydroperiod wetland, while maintaining uplands. This interim goal will be used to measure incremental changes in the spatial distribution of three general habitat types: slough, short-hydroperiod wetland, and upland using hydrologic criteria.

**Significance:** A functioning Everglades ecosystem supporting the natural diversity of the native flora and fauna will consist of all of the habitat types that existed under pre-drainage conditions. CERP's modifications to the water management of the system will restore slough habitat in the greater Everglades while maintaining short-hydroperiod, tussock-forming plant communities in adjacent marl prairies.

### 3.9 Mercury Bioaccumulation

**Goal Statement:** Ensure that water management practices and operations resulting from the implementation of CERP projects do not promote conditions that result in an increase in downstream loading of inorganic and organic mercury and increase

the rate of bioaccumulation of methylmercury in fish. The interim goal for this indicator will measure total mercury levels in estuarine and freshwater fish species.

**Significance:** Mercury is a contaminant of concern in South Florida as well as in many other regions of the United States. This concern stems from the fact that mercury is a persistent bioaccumulative toxicant and, as such, can accumulate in the food web to levels that are harmful to human and ecosystem health. Although much has been learned about mercury biogeochemistry in the last decade, uncertainties exist as to how the implementation of CERP projects will alter, either directly or indirectly, the sedimentary release, downstream loading, and the net methylation or bioaccumulation of mercury in the South Florida environment. Evaluation of mercury bioaccumulation through an interim goal process will assist in ensuring that mercury issues are being addressed.

### 3.10 Submerged Aquatic Vegetation in Estuaries

**Goal statement:** Establish and sustain diverse estuarine seagrass bed communities with moderate densities of plants and increased spatial coverage. The interim goal for seagrass beds is to measure incremental progress towards the establishment of moderate densities of plants, mixtures of key species, and increased spatial coverage.

**Significance:** Seagrass beds are generally considered to be the keystone components of shallow estuarine ecosystems, providing critical food and habitat for shrimp, fish and other organisms. Seagrass beds also help to stabilize sediments, promoting clear water and helping to minimize algal blooms. Seagrasses are known to be sensitive to salinity and water quality changes.

### 3.11 American Oysters in Estuaries

**Goal statement:** Restore oyster beds within the St. Lucie, Caloosahatchee, and Southern Biscayne Bay estuaries, and lower Gulf Coast river mouths, including the restoration of habitat function and oyster health, in areas that are indicated to be suitable habitat. The interim goal for oysters is to measure the incremental progress in the restoration of the spatial extent of oyster beds and oyster health.

**Significance:** The American oyster is an almost exclusively estuarine bivalve mollusk. It is ecologically important because it is a filter feeder, serves as prey for numerous higher animals, and creates habitat for other aquatic organisms. Because oysters are immobile throughout most of their life cycle, they have adapted to a wide range of environmental conditions. The range of salinity needed to sustain a healthy oyster population varies geographically and seasonally within the estuaries. Restoration of beneficial patterns of freshwater flow into South Florida estuaries should provide for the reestablishment of healthy oyster beds.

### 3.12 Lake Okeechobee Ecological Communities

**Goal Statement:** Increase the lake's native vegetation mosaic, both littoral and near-shore submerged/emergent aquatic plant communities. The interim goal for this ecological indicator will be assessed by measuring recolonization, spatial extent, and community diversity of littoral zone and submerged aquatic plant communities.

**Significance:** Ecological plant communities of Lake Okeechobee provide important nesting and foraging habitat for native fish and wildlife species and provide support for a significant commercial and recreational fishery. This vegetation mosaic has been severely degraded due to loss and degradation of both littoral zone emergent and near-shore emergent vegetation due to high water levels, turbidity, and expansion of exotic plants in the littoral zone. Implementation of CERP components (in conjunction with implementation of the Lake Okeechobee Protection Plan) is expected to provide for conditions that result in an increase in submerged and emergent plant communities and thus provide for recovery of supporting fish, wading birds, and other wildlife.

## Proposed List of Benchmarks for Other Water-Related Needs

### 1.1 Ability to Meet Water Supply Needs in the Lower East Coast Service Area

**Goal Statement:** This benchmark is used to measure the ability to meet municipal, industrial and agricultural water demands. The characteristics of water supply to be measured include the frequency, duration and severity of water restrictions imposed during droughts to conserve water supplies for future use.

**Significance:** A goal of CERP is to store water in the regional system for delivery to the Lower East Coast Service Area to supplement local supplies and minimize water restrictions. The increase in regional storage capacity provided by CERP will increase the probability of avoiding water restrictions during droughts. The Lower East Coast Service Area includes Palm Beach, Broward, Miami-Dade and Monroe counties.

### 1.2 Ability to Meet Water Supply Needs in the Lake Okeechobee Service Area

**Goal Statement:** This benchmark is used to measure the ability to meet agricultural water demands. The characteristics of water supply to be measured include the frequency, duration and severity of water restrictions imposed during droughts to conserve water supplies for future use.

**Significance:** A goal of CERP is to store water in the regional system for delivery to meet environmental and other-water related needs in South Florida. This additional capacity to store water will alleviate demands on Lake Okeechobee enabling a greater volume of water supply needs of the Lake Okeechobee Service Area to be met. The increase in regional storage capacity provided by CERP will increase the probability of avoiding water restrictions during droughts. The Lake Okeechobee Service Area includes those areas that use the lake for water supply. This includes the Everglades Agricultural Area, the Seminole Tribe of Florida Brighton and Big Cypress Reservations, Caloosahatchee Basin, St. Lucie Basin, the S-4 Basin, and the L-8 Basin. Water deliveries to these basins include water for agriculture, production, and public consumption.

### 1.3 Ability to Prevent Saltwater Intrusion of the Biscayne Aquifer

**Goal Statement:** This benchmark is used to measure the ability to maintain water levels in the primary coastal canals of the Central and Southern Florida (C&SF) Project at levels adequate to prevent salt-water intrusion in the Biscayne aquifer. The characteristics to be measured include the duration and frequency canal levels are not maintained.

**Significance:** A goal of CERP is to store water in the regional system for delivery to the Lower East Coast Service Area to minimize salt water intrusion in the Biscayne aquifer. The increase in regional storage capacity provided by CERP will increase the ability to maintain canal levels and assist in alleviating water restrictions during droughts and saltwater intrusion of the Biscayne aquifer.

### 1.4 Maintenance of Current Level of Flood Protection

**Goal Statement:** Ensure the level of service of flood protection in existence on the date of enactment of WRDA 2000 and in accordance with applicable law is maintained, or improved consistent with restoration compared with the pre-CERP baseline conditions. This benchmark would use indicators such as water stage, duration, and frequency for comparison with service conditions on December 11, 2000.

**Significance:** A goal of CERP is to enhance economic values and social well being by maintaining or enhancing the current level of flood protection. By avoiding increased flood damages or mitigating for flood encroachment, increases to project and societal costs can be minimized.

## **References**

Department of Defense (DOD). August 2002. Programmatic Regulations for the Comprehensive Everglades Restoration Plan; Proposed Rule. Federal Register, Department of the Army, Corps of Engineers. 33 CFR Part 385. Washington, D.C.

RECOVER. 2002. Draft Monitoring and Assessment Plan. South Florida Water Management District; West Palm Beach, FL.

Water Resources Development Act of 2000. Public Law 106-541. Title IV, Section 601, Comprehensive Everglades Restoration Plan.

## **Appendix A: Process to Establish and Refine Interim Goals for Restoration of the Natural System and Benchmarks for Other Water-Related Needs for the Comprehensive Everglades Restoration Plan**

### **Introduction**

Development of a process to establish interim goals to "ensure the protection of the natural system consistent with the goals and purposes of the Plan" is a requirement of the Water Resources Development Act (WRDA) of 2000 (Public Law 106-541). The "Plan" refers to the Comprehensive Everglades Restoration Plan (CERP). The Restoration Coordination and Verification (RECOVER) program, as the science and technical program in support of CERP implementation, has been charged with the development of this process. The draft Programmatic Regulations for the Comprehensive Everglades Restoration Plan (DOD, 2002) provide that RECOVER shall recommend a set of interim goals for the implementation of CERP.

As initially envisioned when this process document was first drafted (Fall 2001), interim goals would include the other water-related needs of the region, including water supply and flood protection. The draft programmatic regulations, however, make a distinction between interim goals to assess the restoration success of the Plan and "Evaluating progress on achieving other water-related needs of the region provided for in the Plan." In the regulations, RECOVER also has the responsibility of developing recommendations for these other water-related needs. Although the regulations currently describe these other progress-type goals as *targets* for other water-related needs, the RECOVER subteam working on this process has adopted the term *benchmarks* instead of targets.

The establishment of both interim and long-term goals and benchmarks is essential to the success of CERP. The goals and benchmarks should guide the implementation of CERP by identifying collectively shared objectives, and will provide assurance during the critical first phases of implementation that our cooperative efforts have resulted in tangible and measurable improvements. The establishment of interim goals and benchmarks will communicate our commitment to ensuring that the goals and objectives of CERP are being met.

Both federal and state laws mandate that certain reporting requirements regarding CERP be met. WRDA 2000 calls for a report that "the Secretary [Army] and the Secretary of the Interior, in consultation with the Environmental Protection Agency, the Department of Commerce, and the State of Florida, shall jointly submit to Congress a report...[that includes] progress toward interim goals." These reports are to be completed not less often than every five years. Florida's "Everglades Restoration Investment Act" of 2000



requires that an annual report on funds received and expended, and the progress made in the implementation of CERP be prepared for the Governor, President of the Senate and Speaker of the House of Representatives, with copies being made available to the public (Section 373.470(7), Florida Statutes). This annual report was published as a stand-alone document for fiscal years 2000 and 2001 (SFWMD and FDEP, 2000, 2002). Beginning with fiscal year 2002, the annual report was included in the Everglades Consolidated Report (SFWMD, 2002). Potential reporting mechanisms for the interim goals and benchmarks include the Adaptive Assessment Report, yearly reports to the state, five-year reports to Congress, the CERP Annual Report Card and the Everglades Consolidated Report.

## **Background**

Interim goals and benchmarks are means by which success of restoration and achieving other water-related needs may be evaluated throughout the implementation process. Interim goals may be milestones (*i.e.*, short-term quantitative targets) or they may be trends (*i.e.*, directions of change). Interim goals and benchmarks provide a basis for reporting on the progress made at specified intervals of time towards the successful implementation of CERP, and for periodically evaluating the accuracy of predictions of system responses to the effects of CERP. Interim goals and benchmarks are useful to policy-makers, state legislators, Congress, scientists, and the general public and will provide guidance to project delivery teams.

An interim goal or benchmark can be defined by an indicator, which is an element or component of the natural or human system that is expected to be positively influenced by CERP, and that has been selected to be measured as representative of a class of system responses that are desirable. Such indicators would fall into one of two broad categories. The first category is comprised of those indicators that are expected to respond directly to CERP and may be accompanied by a predictable target. A target is a measure of change by the indicator that is expected during and following the implementation of CERP. The second category consists of those indicators that exhibit responses to CERP implementation along a desirable trend. The process of developing interim goals and benchmarks will be relatively straightforward for targets (*e.g.*, hydrological responses or water supply measures), but more complex for trends (*e.g.*, ecological processes such as wading bird nesting success). It is expected that the development of these goals and benchmarks will be an iterative process in which indicators, targets and trends will be reviewed and revised periodically as new information becomes available.

Interim goals, to be meaningful, must be quantifiable, flexible and science-based. Benchmarks must also be quantifiable and based upon current water law and policy. The initial interim goals and benchmarks will be based upon the predictions of the status of each indicator at appropriate intervals and reporting increments, and will continue throughout the implementation of CERP, allowing for refinement through the adaptive assessment process as we learn more, and adjustment as schedules change due to unknown or unforeseen circumstances.

## **The Team**

An interagency, interdisciplinary planning team composed of RECOVER members and others has been established. Initially this team vetted this proposed process and has begun to work through the process to develop the actual interim goals and benchmarks for other water-related needs (see Figure 1). Additional scientific expertise will be infused into the process as necessary to develop the interim goals and benchmarks. As called for in the draft programmatic regulations, an "Interim Goals Agreement" will be created by the Secretary of the Army, the Secretary of the Interior and the Governor of the state of Florida, upon consideration of the recommendations of RECOVER. The regulations also state that targets [benchmarks] for evaluating other water-related needs shall be established by the Corps of Engineers and the South Florida Water Management District, again upon consideration of the recommendations of RECOVER. The development of the interim goals and benchmarks will undergo consultation with federal, state and local agencies, tribal governments and the South Florida Ecosystem Restoration Task Force. Additional opportunities for public input will also be provided..

## **The Process**

*Step one:* The sources for the selection of indicators for interim goals and benchmarks for other water-related needs will be built upon existing planning documents (e.g., draft Monitoring and Assessment Plan (RECOVER 2002), Total System Conceptual Ecological Model [in prep], Update to the CERP Master Implementation Schedule (USACE and SFWMD, 2001), regional water supply plans (SFWMD, 1998, 2000a and 2000b), and the South Florida Ecosystem Restoration Task Force Strategic Plan (SFERTF, 2002)).

*Step two:* Criteria will be established to select a sub-set of the total indicators possible for the interim goals and benchmarks for other water-related needs. The criteria will be consistent with the goals and objectives of CERP.

*Step three:* A list of indicators for the interim goals and benchmarks will be created, using the criteria established above. For each indicator, the appropriate interval over which it will be evaluated will be identified.

*Step four:* The list of indicators for the interim goals and benchmarks for other water-related needs created in step three will be vetted to agencies, stakeholders and the public through suitable venues. Refinements will be made to the list based on the vetting process.

*Step five:* Information will be gathered in order to set interim targets or trends for the indicators from the best currently available science and predictive tools and planning documents such as the South Florida Water Management Model (SFWMM) and other predictive models, the Update to the CERP Master Implementation Schedule, and other

planning documents and regulatory requirements. Model results will be analyzed to develop information to set the targets or trends for the indicators.\*

*Step six (a):* For the indicators with adequate information, targets for interim goals and benchmarks for other water-related needs will be set.

*Step six (b):* Where more information is needed to set targets, the information needs will be identified and the Adaptive Assessment Team of RECOVER will develop processes and a schedule to gain needed information. As information becomes available, targets will be set for these interim goals and benchmark indicators. These targets will be scientifically peer-reviewed, as they are completed, as appropriate.

*Step seven:* Draft recommendations describing the indicators and their targets will be developed for interim goals and benchmarks for other water-related needs on the schedule required by the programmatic regulations.

*Step eight:* The draft recommendations will be vetted through the same process used in step four and revised as necessary.

*Step nine:* The Secretary of the Army, Secretary of the Interior and the Governor of the State of Florida will approve/approve with revisions the recommendations for interim goals. The Corps of Engineers and the South Florida Water Management District will approve/approve with revisions the recommendations for other water-related needs.

*Step ten:* The interim goals and benchmarks for other water-related needs will be reviewed and revised at least every five years. New information will be gathered continuously to revise and update the interim goals and benchmarks, but new interim goals and benchmarks documents will only be produced and reported on every five years.

\* Dependent upon the Initial CERP Update with modeling scheduled to begin January/February 2003.

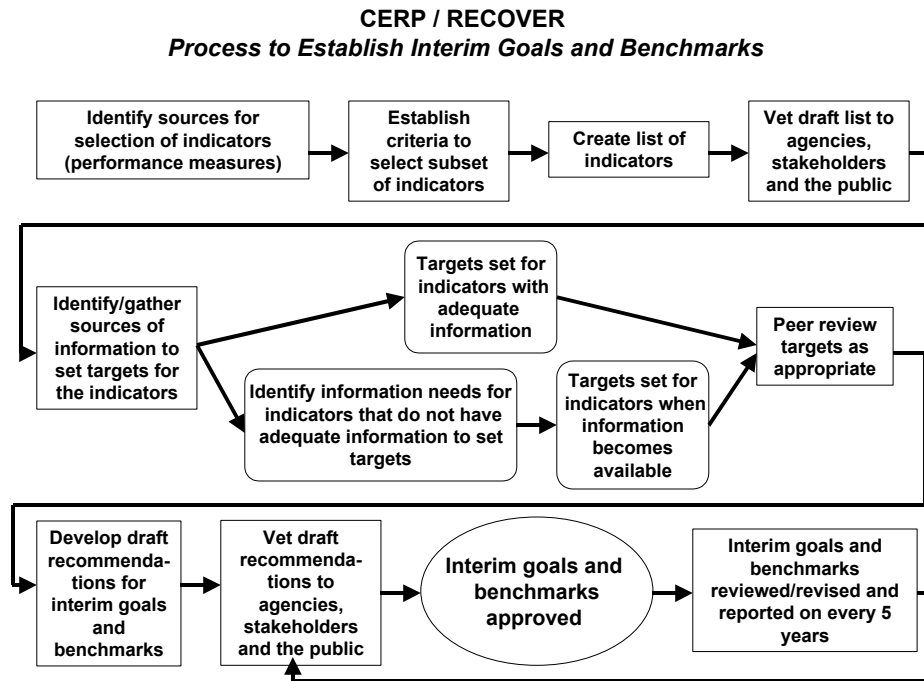


Figure 1

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## **APPENDIX B: Interim Goal Criteria and Guidelines**

### **A. Consistent with Goals and Purposes of CERP**

Interim goals must be consistent with the goals and purposes of the Comprehensive Everglades Restoration Plan

The overarching objective of the Plan is the restoration, preservation, and protection of that part of the South Florida ecosystem covered by the Plan while providing for other water-related needs of the region. The Plan recognized two general goals - enhance ecologic values and enhance economic values and social well being. The Plan listed three guiding objectives for enhancing ecologic values: increase the total spatial extent of natural areas, improve habitat and functional quality, and improve native plant and animal species abundance and diversity. These concepts therefore provide a basis for formulating interim goals.

### **B. Address the Physical (Quantity, Quality, Timing, Distribution of Water) and Biological Aspects of the Plan**

Interim goals must be measurable hydrologic and ecological indicators that include short-term, intermediate, and long-term responders.

Interim goals should be represented in a way that provides a measure of benefits of the Plan to the natural system and the human environment by describing the requisite changes in hydrology, water quality, and other ecological attributes. As indicators, restoration targets can be derived from a combination of hydrological and ecological performance measures, adaptive assessment monitoring parameters, and output from physical and ecological models. The implementation of CERP components will take decades to complete and, once finished, several more decades may pass before the ecosystem fully responds to the changes that have been made. Therefore, interim goals should provide evaluations of short-term, intermediate, and long-term responses to changes that occur.

### **C. Consistent with the RECOVER Monitoring and Assessment Plan**

Interim goals should be consistent with the RECOVER Monitoring and Assessment Plan (MAP)

The RECOVER MAP being developed by the Adaptive Assessment Team provides a set of measurable indicators that document responses of the physical stressors and ecological attributes that result from the implementation of CERP. The monitoring parameters identified in the MAP have been selected such that they represent the most critical restoration expectations consistent with the purposes and design of CERP.

D. Predictable and Easily Interpreted

Interim goals should have a reasonable level of predictability and should be easily interpreted by a broad audience.

The selection of indicators to be used to establish interim goals should, to the extent practicable, be predictable relative to environmental changes expected to result from the implementation of CERP. Interim goals will be based on predictions, either derived from models or from best professional opinion, of the status of each indicator at certain points during the implementation of CERP. Interim goals must be defined such that they are easy to understand and provide information to managers and policy-makers that is relevant, scientifically defensible, and easily documented. It is also important that interim goals provide a way to report project benefits to the general public as an assurance that the Plan is achieving its stated goals and purposes.

## **Appendix C: Explanation and Justification for Elimination of Indicators from the Interim Goal and Benchmarks Lists**

Restoration goals from the RECOVER Adaptive Assessment Team's Monitoring and Assessment Plan (MAP) and from the Total System Conceptual Ecological Model were used to prepare the initial list of interim goal statements (IGS) provided in this document. The MAP and the Total System Conceptual Model contain lists of performance measures and assessment tools that were developed for the south Florida ecosystem.

Once the restoration goals were defined, several indicators were eliminated for various reasons. These indicators are described below in order to provide a documentation of those indicators and to recognize that it may be possible and desirable to include these goals as interim goals in the future.

Control of Nuisance and Exotics. While the implementation of CERP should assist in the control of these species by returning to more natural hydrologic conditions, it does not include specific exotics control activities and therefore is not expected to achieve success with respect to control of exotics on a system-wide basis. Exotics have been included in other goals including the tree island goal because the presence of exotic species affects tree island health.

Pre-drainage Pattern of Tidal Creeks in Mangrove Estuaries. This aspect of ecosystem restoration was judged to be difficult to predict temporally and is perhaps too detailed a restoration goal to be indicative, on a larger scale, of CERP success.

Relationships within the Everglades Food Web. Rather than setting goals for each of these relationships, the interim goal statements in this document sought to represent the importance of trophic levels using a select set of these relationships. These include: periphyton, fish, alligators, and wading birds.

Alligators and Crocodiles. The MAP provides restoration goals for crocodiles (not represented in the proposed list) and also provides additional restoration goals for alligators. The alligator goal proposed above was considered by the team to be the most representative of the expected improvements in alligator populations system-wide as a result of CERP. Crocodiles were not included in the proposed list mainly because they are not represented system-wide and because their populations are not expected to be indicative of CERP success.

Algal Blooms in Lake Okeechobee. The MAP considers the frequency and intensity of algal blooms in Lake Okeechobee. The team assembling the interim goal statements did not believe algal blooms are either quantitatively predictable or directly indicative of CERP success.



Lake Okeechobee Aquatic Organisms. Changes in native submerged and emergent plant communities were chosen to represent the overall health of the biology of Lake Okeechobee as they were assumed to be more responsive to stressors and more accurately predictable.

Water Quality and Nutrient Loading to Estuaries. This is an important stressor for many of the south Florida estuaries. However, the linkage to restoration benefits expected as a result of the implementation of CERP projects is not as clear as salinity regimes and fresh water discharges.

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